

Sock It To Car Exhaust

Author:

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Grade Level/Subject:

8th Grade/Earth Science

Curriculum Standards:

Content Standard A

Understandings About Scientific Inquiry

- Scientific investigations sometimes result in new ideas and phenomena for study, generate new methods or procedures for an investigation, or develop new technologies to improve the collection of data. All of these results can lead to new investigations.

Content Standard D

Structure of the Earth System

- Living organisms have played many roles in the earth system, **including affecting the composition of the atmosphere**, producing some types of rocks, and contributing to the weather of rocks.

Content Standard F

Populations, Resources, and Environments

- When an area becomes overpopulated, the environment will become degraded due to the increased use of resources.

Natural Hazards

- Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.

Risks and Benefits

- Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earth quakes, and volcanic eruptions), with chemical hazards (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).



- Individuals can use a systematic approach to thinking critically about risks and benefits. Examples include applying probability estimates to risks and comparing them to estimated personal and social benefits.

Science and Technology In Society

- Technology influences society through its products and processes. Technology influences the quality of life and the ways people act and interact. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.

Overview:

In recent years, population growth has resulted in increased energy consumption. Due to this increase in energy use, humans have injected harmful elements into the atmosphere. More than half of the present atmospheric pollution is released by automobiles. The U.S. Environmental Protection Agency regulates five criteria air pollutants emitted by motor vehicles, they are: lead, carbon monoxide, nitrogen oxides, ozone, and particulate matter.

Purpose:

The purpose of this activity is to allow students to identify common sources of air pollution. Students will be introduced to pollutants that are produced by motor vehicles and how those pollutants damage the environment and human health.

Learning Objectives:

Students will be able to:

- scientifically analyze information and apply the findings to observed or known conditions
- identify air pollutants created by automobiles
- understand the impact of air pollution on the environment and our health
- search the internet to identify solutions to pollutant emissions

Vocabulary:

- pollution
- criteria pollutants
- particulate matter
- emission

Resources/Materials:

- paper
- pencils
- handouts
- white tube socks
- oven mitts
- magnifying glasses
- markers
- masking tape
- rubber bands
- access to several vehicles
- access to internet ready computer lab

Preparatory Activities: (3 days)**Day 1**

(10 min) Discuss criteria pollutants and their composition (lead [Pb], carbon monoxide [CO], nitrogen oxides [NO_x], ozone [O₃], particulate matter [PM], and sulfur dioxide [SO₂]).

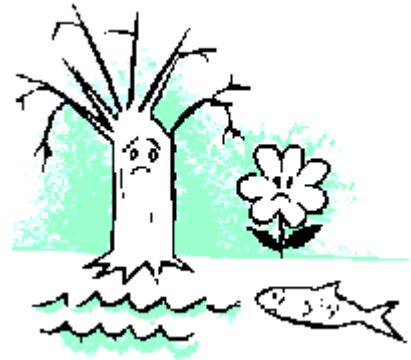
(15 min) Assemble in small groups to identify pollution sources in the community and complete “Pollution Sources” handout (pg. 6).

(10 min) Discuss “Pollution Sources” handout.

(15 min) Identify and discuss the impacts of air pollution on the environment and human health (e.g. acid rain, climate change, negative health effects).

Why should you be concerned about air pollution?

- Air pollution can make you sick. It can cause burning eyes and nose and an itchy, irritated throat, as well as trouble in breathing. Some chemicals found in polluted air cause cancer, birth defects, brain and nerve damage and long-term injury to the lungs and breathing passages. Some air pollutants are so dangerous that accidental releases can cause serious injury or even death.



- Air pollution can damage the environment. Trees, lakes and animals have been harmed by air pollution. Air pollutants have thinned the protective ozone layer above the Earth; this loss of ozone could cause changes in the environment as well as more skin cancer and cataracts (eye damage) in people.
- Air pollution can damage property. It can dirty buildings and other structures. Some common pollutants eat away stone, damaging buildings, monuments and statues.
- Air pollution can cause haze, reducing visibility in national parks and sometime interfering with aviation.

Source: EPA [The Plain English Guide to the Clean Air Act](#)

Day 2

(15 min) Describe air pollution produced by vehicles (Pb, CO, NO_x, O₃, and PM).

(5 min) Assemble students in parking lot with pre-selected vehicles (different engine types, model years, etc.)

(5 min) Prepare labels for socks using masking tape and markers.

Make: _____
Model: _____
Year: _____
Engine: _____

(5 min) Allow students to attach socks to automobile tail pipes by placing sock over opening and securing it with rubber bands.

(5 min) Start engines and allow the vehicles to idle. Turn engines off after approximately 5 minutes.

(5 min) Using extreme caution (tail pipes will be very HOT), remove the socks using oven mitts. Turn the socks inside out and attach the labels.

(10 min) Discuss the results by asking students to identify which vehicles produced the most visible pollution. Compare particle content to particle size handout (pg. 7) using magnifying glasses. Ask students to predict what influenced pollution emission levels of the selected vehicles (e.g. tune-ups, engine type, year, etc.).

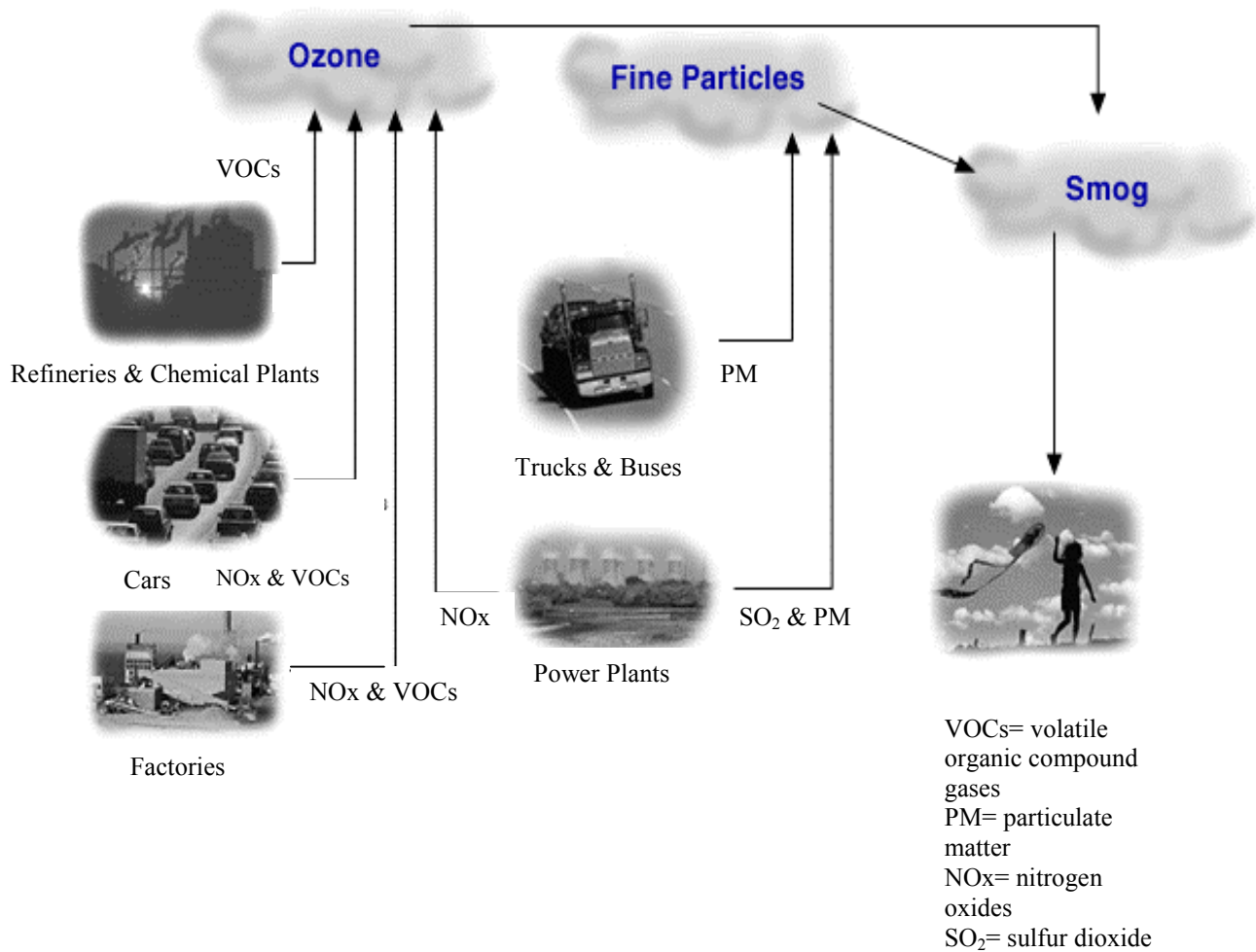
Day 3

(10 min) Assemble students in computer lab and review internet operation.

(30 min) Allow students to search the Internet for emission reduction strategies (alternative transportation, exhaust system retrofits, alternative fuels, carpooling, etc.)

(10 min) Allow students to report and discuss their findings.

Pollution Sources

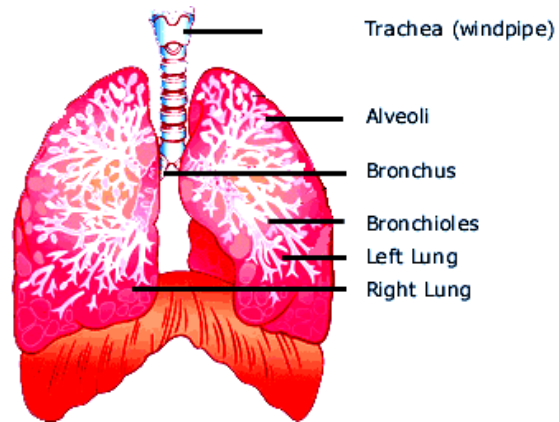


Source: EPA [Regulating Smog and Particle Air Pollution: An Integrated Approach](#)

Circle the sources of air pollution that exist in your community!

Measuring Particle Pollution

The size of the particles is what's most important from a public health viewpoint. Particles larger than 10 micrometers generally get caught in your nose and throat, never entering the lungs. Particles smaller than 10 micrometers can get into the large upper branches, just below your throat, where they are caught and removed (by coughing and spitting or by swallowing). Particles smaller than 5 micrometers can get into your bronchial tubes at the top of the lungs. Particles smaller than 2.5 micrometers in diameter can get down into the deepest (alveolar) portions of your lungs where gas exchange occurs between the air and your blood stream with oxygen moving in and carbon dioxide moving out.

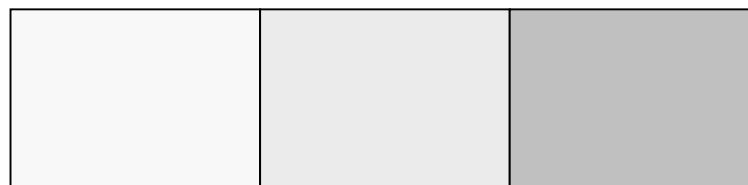


Studies indicate that fine-particle pollution is causing or exacerbating a wide range of human health problems, including: initiating and worsening asthma; increasing hospital admissions for bronchitis, asthma, and other respiratory diseases; increasing emergency room visits for respiratory diseases; reducing lung function; increasing upper respiratory symptoms (runny or stuffy nose; sinusitis; sore throat; wet cough; head colds; hay fever; and burning or red eyes); increasing lower respiratory symptoms (wheezing; dry cough; phlegm; shortness of breath; and chest discomfort or pain); and heart disease.

Source: Rachel's Environment & Health Weekly [The Holy Grail of Scientific Certainty](#)

*****One micrometer [μm] = 1/100,000 meter [m]*****

How does the particle content in your sock compare with the scale below?



350 μm

280 μm

100 μm

(actual size)

Activity	Excellent	Satisfactory	Unsatisfactory
“Pollution Sources” worksheet	Correctly completed worksheet	Incorrectly completed worksheet	Didn’t complete worksheet
“Sock It To Car Exhaust” activity	Actively participated in activity	Passively participated in activity	Didn’t participate in activity
“Emission Reduction Strategies” internet search	Reported accurate strategies	Reported inaccurate strategies	Didn’t report strategies